

Status of the European Laser Timing ELT Detector package

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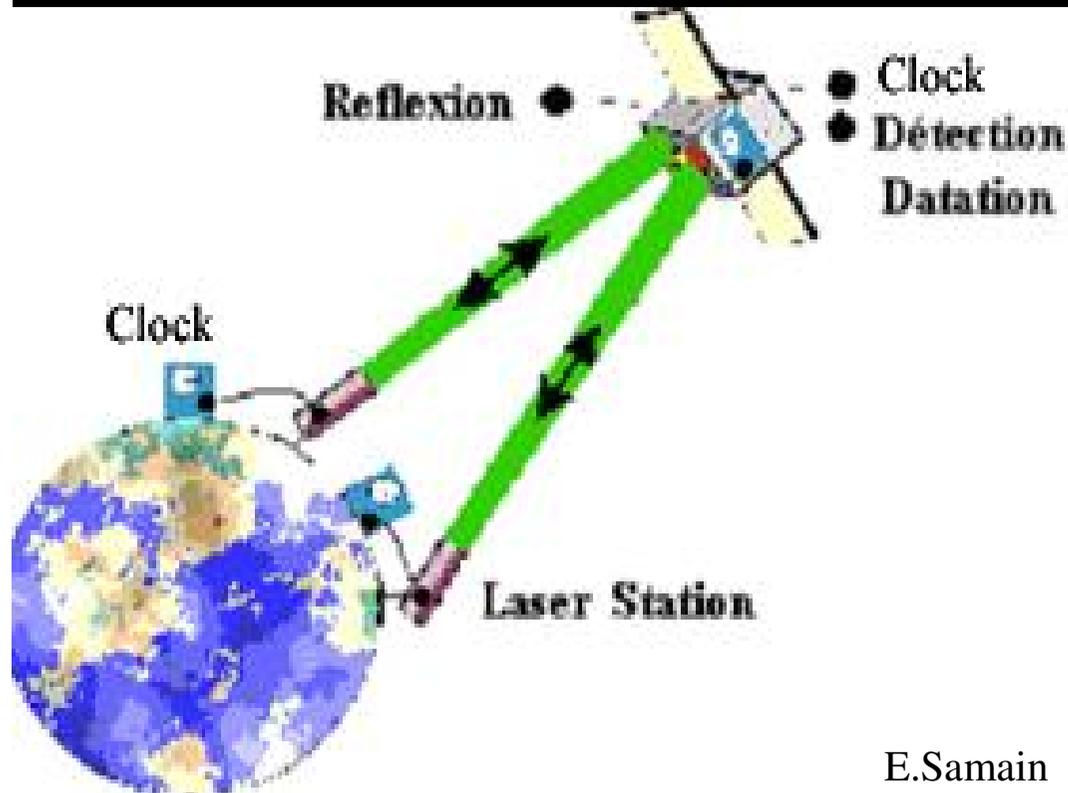
presented at :

17th Workshop on Laser Ranging, Bad Kotzting, May, 2011



Czech Technical University in Prague, Czech Republic
Technical University Munich, Germany

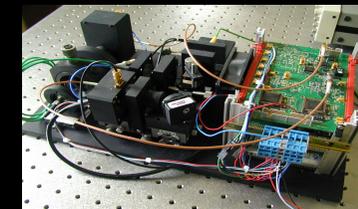
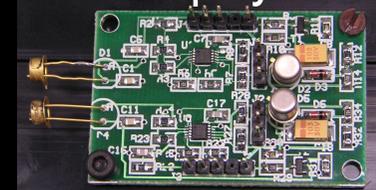
Laser Time Transfer in Space



- Time and frequency transfer using ps laser pulses in space
- Relying on available technology and ground segment Satellite Laser Ranging
- Superb precision and accuracy
- Navigation, deep-space, fundamental physics...

- LTT – China since April 2007
China Compass-M1 / Beidou
- T2L2 CNES - France since June 2008
JASON-2
- LTT – China , August 1, 2010,
CompassM2 Beidou, IGSO

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European Laser Time Transfer History review

- “H maser in space”, '94, France + Russia + Prague canceled
- LTT China + Prague
Compass M1 Beidou, (operational since Aug. 2007)
- T2L2 E. Samain et al
ACES -> Miriade -> Jason 2 (operational sine June 2008)
- ELT proposed by CTU Prague and TU Munich, June 2008
- Investigators Working Group established Dec. 2008
- Ground tests (Prague, Munich) started Dec. 2008

ELT Principal participants and contributors

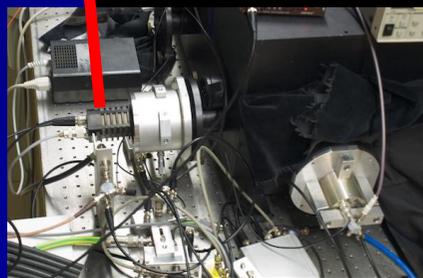
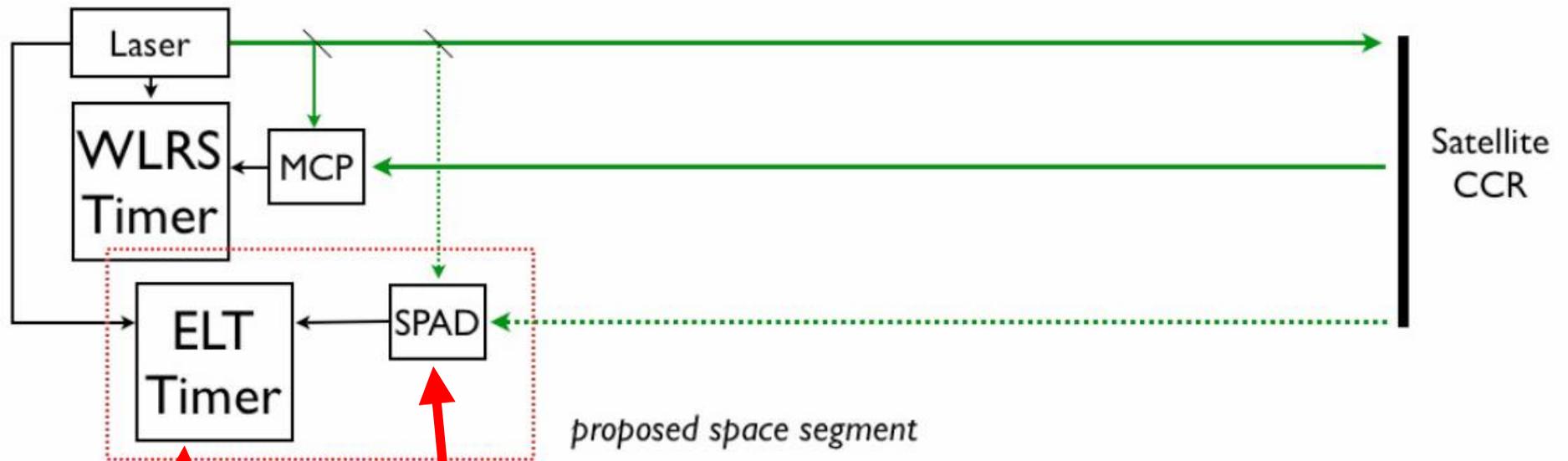
- Luigi Cacciapuoti, ESTEC, The Netherlands
ESA coordination
- Urs Hugentobler, Tech. Univ. Munich, Germany
space geodesy
- Pierre Lauber, TU Munich, Germany
Satellite Laser Station Wettzell
- Ivan Prochazka, Czech Tech.University in Prague
Instrument Science coordinator
- Wolfgang Schaefer, TimeTech, Germany
timing devices
- Ulrich Schreiber, Tech.Univ.Munich & BKG Germany
Data Analysis Coordinator
- Anja Schlicht, Tech.Univ. Munich
Data Analysis Center

Wettzell ground demonstration experiment

December 2008 – May 2009



Ground demonstration of the entire timing performance via a space target and SLR combined



Progress in ELT project

Prague group ELT activities

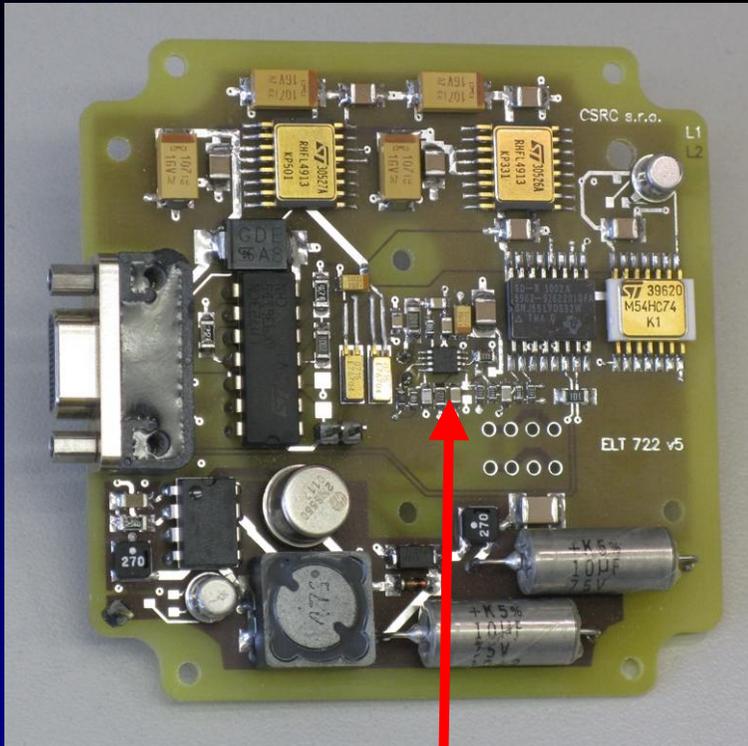
- Detector design & construction
 - electronics
 - optics
 - mechanical
- Functional testing and test procedures
Prague labs, Graz SLR
- Development of procedure for internal delay measuring
- Calibration of receiver Attenuation / sensitivity
- Radiation tests



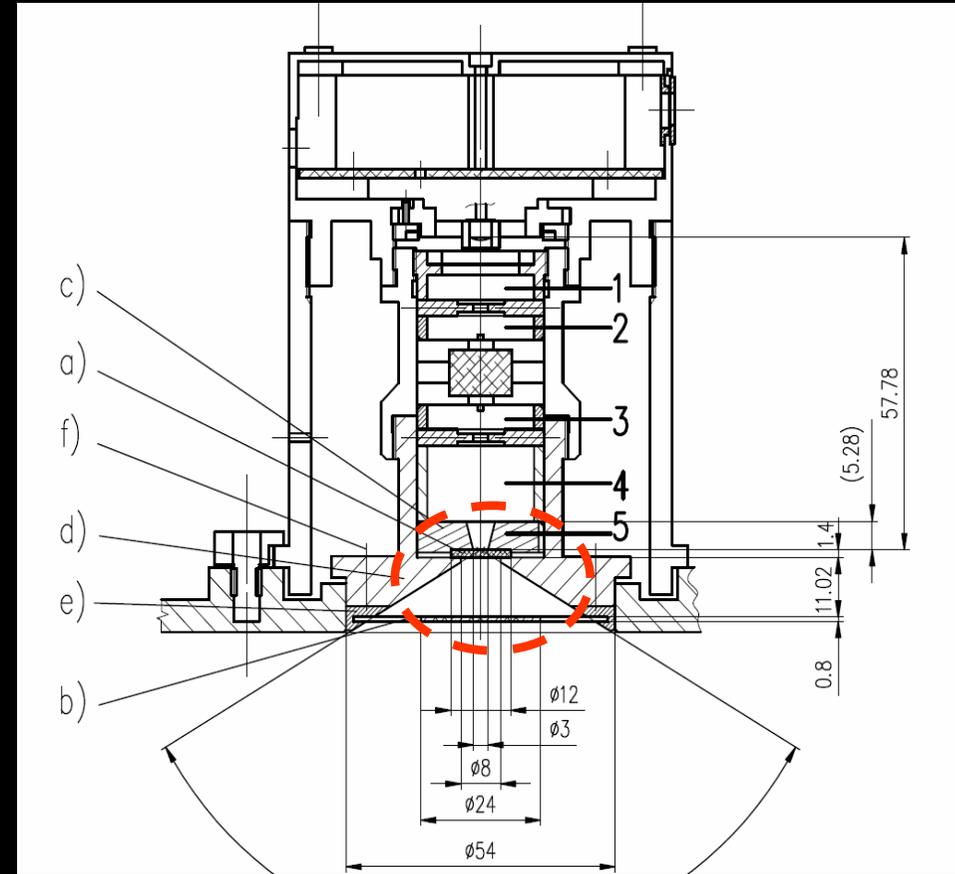
BB3 assembly at CTU in Prague
left to right J.Kodet, J.Brinek, J.Blazej

Electronic mechanical design

direct "follow – on" of the previous versions
CSRC Brno

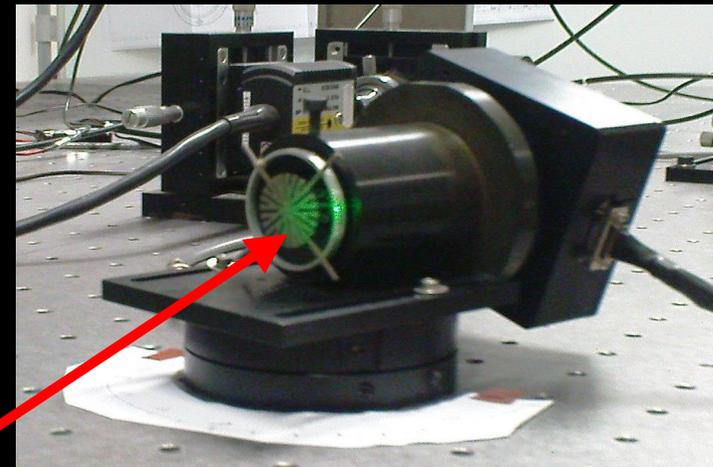
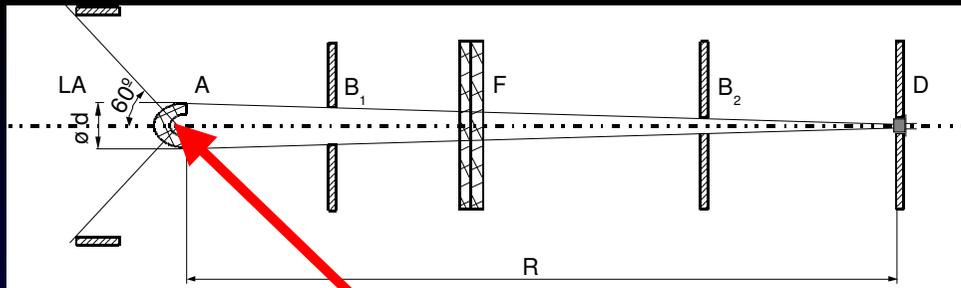


All space qualified components
Except of ADCMP 553
fast comparator, see later



Input optics

Optical design



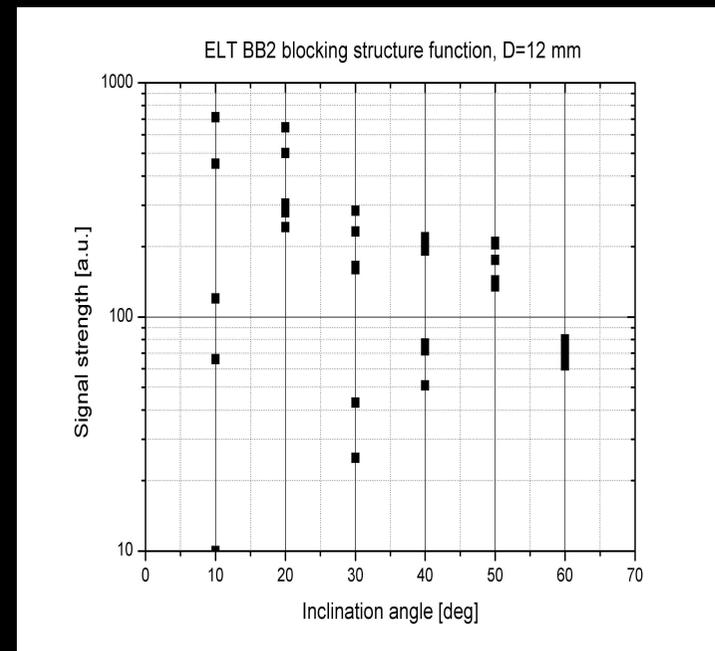
Input optics

Wavelength selection, attenuation, FoV

Flat diffuse, Cylinder, Hemisphere, etc

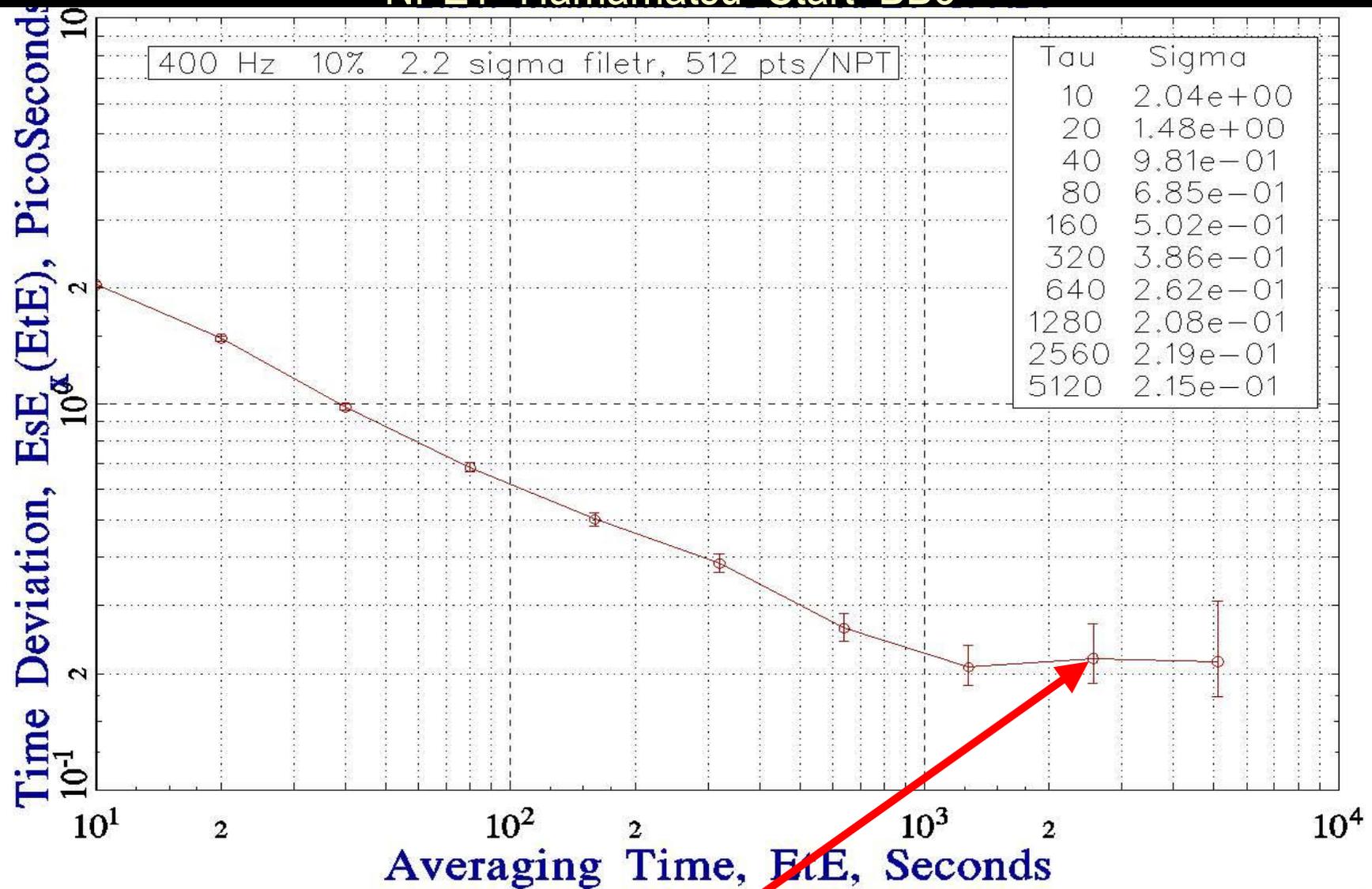
Flat diffuse + shield

- Simple optical design
- No technology problems
- Signal strength well within 1 order of mag. for 10-60 deg.
- No impact on timing properties
- “Macrolon” input window



ELT timing test, Prague, 2011

NPET+Hamamatsu+Start+BB3

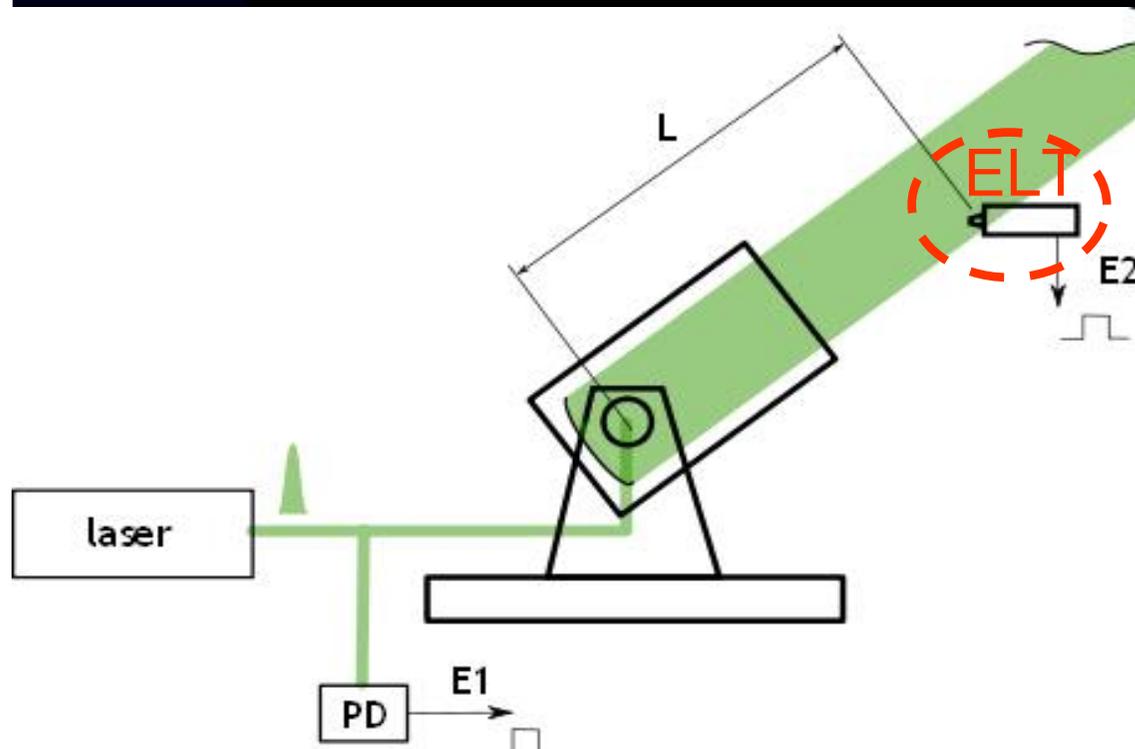


Entire chain stability ~ 200 fs / hours, +/- 2 K

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ELT delays measurement

Ground + Space segments SIMULTANEOUS REFERENCING



Both GROUND & SPACE “absolute delays” will be characterised by a single calibration value / station.

The ELT Engineering Model will be used to detect and time tag in a local time scale

Calibration value computed from - epoch dif. $(E2-E1)$
- geometry distance L

Calibration campaigns – will be organised by TUM and CTU (2014?)
in cooperation with ILRS (Transponder Working Group)

presented at IWG#32 Paris April 2010

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Conclusion

- European Laser Timing ELT construction is in progress
- We are looking for the participating SLR stations
on-site H maser
laser fire +/- 100 ns
- SLR sites calibration campaigns prior / just after the launch